MEAT RESERCH
NEWSLETTER
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Meat Research News Letter

CSIRO Division of Food Research
Meat Research Laboratory

Enquiries on technical matters relating to the meat industry should be sent to the Laboratory's Information Officer

P.O. Box 12, CANNON HILL, BRISBANE, QLD. 4170
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Date 9th February 1978 **Number** 78/1

GALL RECOVERY

Gall is a valuable byproduct of the meat processing industry. It is recovered from the gall bladder of cattle and sheep during the slaughter and dressing operation, and in Australia it is concentrated by heating to a solids content of 75% for sale and shipment.

Gall is recovered at the viscera table when the gall bladder is removed from the liver after inspection. Sheep bladders are removed simply by tearing the bladder away from the liver. The best method of removing beef bladders is to grasp the bladder in one hand, spin the liver on the viscera table with the other, and cut the string of connective tissue thus formed with a knife.

Traditionally, the beef gall bladder is slashed and the gall drained (splashed) into a receiving vessel. In this process, varying quantities of gall are lost either between the table and the collection facility or as remnants in the bladder after draining. This statement is borne out by the fact that the yield of gall actually leaving the works varies between 40% and 80% of that available, assuming a 90% yield is achievable using traditional methods. These losses may be reduced by improving recovery at the viscera table, using a gall extraction machine, or by improving gall concentration.

Present techniques can undoubtedly be improved by *closer supervision, more operator care, control, and skill.* The improvement may last for some time, but once the supervision is reduced, or the operator loses interest, yields will fall.

The gall extraction machine works on the principle of crushing the bladders between sets of rollers and squeezing out the gall.

Gall bladders are directed into hoppers on top of the machine*, from where they pass down through the roller mechanism which squeezes out the gall. There are separate hoppers and different roller mechanisms for beef bladders and mutton bladders.

The extracted gall is drained off into a collection vessel and the bladder is dropped into a revolving tumbler so that the bladder moves slowly down the full length of the tumbler, draining off any remaining gall. This residual gall is directed to the collection vessel and the empty bladder drops into a collection tray at the end of the machine. The machine is capable of handling up to 1,000 beef and 6,000 mutton bladders per hour simultaneously.

The ideal position for the machine is on the level below the kill floor and as near as possible to directly beneath the viscera table. A fluid level control device fitted to the collection vessel enables the gall to be pumped automatically to the concentrator facility.

Evaluation of the Machine* on Beef Gall Yield

The following *potential* gall yield relationship was found to apply:

Animals *heavier* than
200 kg dressed weight .... Average, 0.4 kg

Animals *lighter* than
200 kg dressed weight .... " , 0.3 kg

The following equation can be used to estimate the percentage recovery of potential gall yields:

*Rankin Harper Limited, P.O. Box 22663, CHRISTCHURCH, New Zealand.

Animal >200 kg dressed weight

$$\% \text{ Recovery} = \frac{\text{Quantity collected (kg)} \times 100}{\text{Number killed} \times 0.4}$$

Animal <200 kg dressed weight

$$\% \text{ Recovery} = \frac{\text{Quantity collected (kg)} \times 100}{\text{Number killed} \times 0.3}$$

The evaluation, done in one abattoir, showed that the average gall recovery with the conventional slashing and draining technique was 70%, whereas the *average gall recovery with the gall extraction machine was 90%.*

The observation of 70% recovery, using manual methods, is higher than the 50% yield average determined by previous surveys. A conscious effort to improve gall collection had been made for some time in the plant where these trials were undertaken, and this was no doubt responsible for the 70% yield.

The advantages of the use of a gall extraction machine can be demonstrated by an example:

Works Throughput .... 500 cattle per day

Weight of Gall per Animal .... 0.4 kg

Solids Concentration of Beef Gall 9%

Gall Available .... 200 kg/day

Gall Solids Available .... 18 kg/day

Amount of Concentrate (Based on 75% Solids) ...... 24 kg/day

Value of Gall to Works $3.50/kg

Theoretical Daily Value (Total Gall) $84

Expected Return, Using Gall Extraction Machine $76

Expected Return, Using Old Slashing Technique $59*

The nett difference per year (based on 250 days) between using and not using the gall extraction machine, is a minimum of $4,000. Based on an initial machine cost of approximately $6,000, this represents a maximum pay back period of 18 months. In the case of a meatworks at present recovering somewhat less than 70% of their gall, this pay back period may be considerably lessened.

The concentration procedures for obtaining the 75% solids in the steam coil concentration vessel are quite satisfactory, *provided that the contents do not go dry or become "baked" to the side of the vessel.*

*This figure may be as low as $40 in some plants.

Gall should be concentrated by heating in an open vessel at a temperature of 115°C (10 psi steam) to evaporate moisture. A suitable vessel would have a capacity of about 100 gallons (depending on throughput) and heat can be provided by steam coils in the bottom of the vessel or by a steam jacket around it. Steam coils are preferable because there is less likelihood of a heating surface becoming exposed, with consequent baking-on of residual gall. A stirrer fitted to the vessel assists evaporation of the water, but is not essential.

For efficient concentration of the gall, the solids concentration should be monitored and *the concentrate drummed off when the solids content reaches 75%.*

The following table summarises expected gall yields:

TABLE 1

MEAN GALL WEIGHT (gms) FROM DIFFERENT TYPES OF STOCK

Type	Potential Raw Weight	90% Recovery Raw Weight	75% Solids Weight (based on 90% recovery)
Cattle:			
Carcasses >200 kg	400	360	43
" <200 kg	300 (9% solids)	270	32
Calves (av. wt 23 kg)	40* (8% solids)	36	3.8
Sheep	29 (9% solids)	26	3.1
Lambs	23 (10% solids)	21	2.8

*Large calves (stirk) will be about twice this, and small bobby calves half or less. These figures are a guide only, and processors should assemble their own.

A 90% recovery is possible with an extraction machine. Manual methods may not achieve this figure but works should aim to get as close to it as possible.

ABSTRACTS

Below are some abstracts of recent publications which may be of interest. Copies of publications are restricted to the Australian meat processing industry and can be obtained by completing the attached form. Payment must be made in advance.

"CURRENT INTERNATIONAL ENDEAVOURS IN REGULATING FROZEN FOOD," by W.C.K. Hammer, *Australian Refrigeration, Air Conditioning and Heating*, August 1977. 4p

In recent times there has been a rapid increase in the growth of frozen food industries in many countries. This growth has been accompanied by technological difficulties associated with the production, handling and distribution phases of the frozen food chain the successful operation of which the consumer is dependent upon for the maintenance of product quality and safety. As a consequence much attention has been directed by governments and industry at rectifying these difficulties by extensive research followed by the introduction of regulations, the release of advisory codes of practice, and recommendations for the use of operators involved in this sphere of activity.

"COLD STORES - LOOKING FOR BUSINESS TO HOT UP," by Graham Large, *Meat*, June 1977. 6p

Last summer may have been a godsend for sun-seekers and makers of calamine lotion, but for the cold storage industry it was not a happy time. While the sun was cracking the pavements outside and shrivelling the crops, the cold storage industry was feeling the chill of depression with surplus capacity and nothing to fill it. While there was little the industry was able to do to alter the effects of Mother Nature, there was plenty to be done in order to erase the hated 'five mile cargo handling corridor' section of the Bill before it reached the statute book. However, as storage charges increase, so must the standard of service offered by the cold storage industry. These are the things which will have a big bearing on the industry's growth in the years ahead. The cold storage industry is capable of putting its house in order, and should have no difficulty at all in facing up to the challenge.

"CAN YOU IMPROVE YOUR SUPERVISION?" by Alan Fiber, M.D., *Meat*, June 1977. 2p

The majority of people in the industry - all functions and all levels except the lowest - spend part of each working week supervising. Yet, curiously, very few have ever been taught how to supervise. Considering proper supervision is crucial to correct performance and is often the fuse ending in upset staff relations, dismissals and the handing in of 'notice,' this is remarkable. The efficient supervisor must be able to see the wood for the trees, to know what is essential for the proper carrying out of various duties so that a learner's major faults can be quickly pinpointed and corrected, to appreciate what might develop into an unfavourable trend in inter-staff relationships or the carrying out of duties, to realise what are the essentials of any message to be relayed to others and give correct emphasis, to see all the work for which the supervisor is responsible in its correct perspective.

"HOW PHOSPHATES WORK IN PROCESSED MEATS," by Joseph P. Cassidy, *Meat Processing*, June 1977. 4p

Food Grade phosphates serve as additives in all phases of the meat processing industry, performing such useful functions as curing, moisture retention, emulsification and sequestration, while preserving color, flavor and tenderness.

Many of these functions take place simultaneously, and a single phosphate can be used to impart several qualities to a particular meat product.

The largest use of phosphates in the meat industry occurs in cured meats such as bacon and ham. Sodium tripolyphosphate (STPP) and sodium hexametaphosphate (SHMP) are the two major phosphates for curing and constitute over 90 percent of the total phosphates used in meat processing.

The meat industry, including poultry processing, uses approximately 40 million pounds of phosphates per year. About 85 percent of the quantity goes into cured pork, bacon and ham. Most of the remainder goes into sausage products and luncheon meats, principally frankfurters and bologna.

"FOOD PROCESS MONITORING WITH MICROCOMPUTERS," by Robert J. McQueen, *Food in Canada*, August 1977. 3p

With rising equipment costs and soaring labor rates, a new monitoring system designed to improve productivity may become an important tool for Canadian food processors. The output information displayed on the television monitor can be used in many different ways. A display in the Production Manager's office gives him the ability to react immediately to potential problem situations as they develop.

Machine conditions and speeds are sensed by up to 30 electrical switch closures. The microcomputer also has the calculation capability of its larger brothers.

When installing your first microcomputer system the key thing to look for is the support level of the vendor. It is also valuable to lean on the flexibility of the microcomputer approach when installing your first system.

Time is lost over the whole range of problems that cause production stoppages. Some percentage of this wasted time cost could be eliminated if better operating information were available to operators and managers.

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Date 12th April 1978 **Number** 78/2

DETERMINING THE AGE OF SHEEP & CATTLE FROM THEIR TEETH

This Newsletter explains the relationship between the age of an animal and its teeth. Because meat from younger animals is potentially more tender than that from older animals, the Australian Meat and Live-Stock Corporation classification schemes for sheep and beef carcasses require an examination of the teeth. The carcass is allocated to a dentition category (age), according to the presence or absence of certain teeth.

Sheep and cattle have two sets of incisor and premolar teeth in a lifetime - a temporary set (milk teeth) which is present at birth or soon after, and a permanent set which replaces the temporary set. There are no temporary molar teeth, and molar teeth do not appear until some months after birth (the first molar appearing at about five months, and the third, one to two years later).

The teeth may be divided into two types according to their position in the mouth - the front teeth (the incisors) and the cheek teeth (premolars and molars). Figure 1 shows the relative locations of these teeth in the ox. The arrangement of the teeth in the jaw of the sheep is similar.

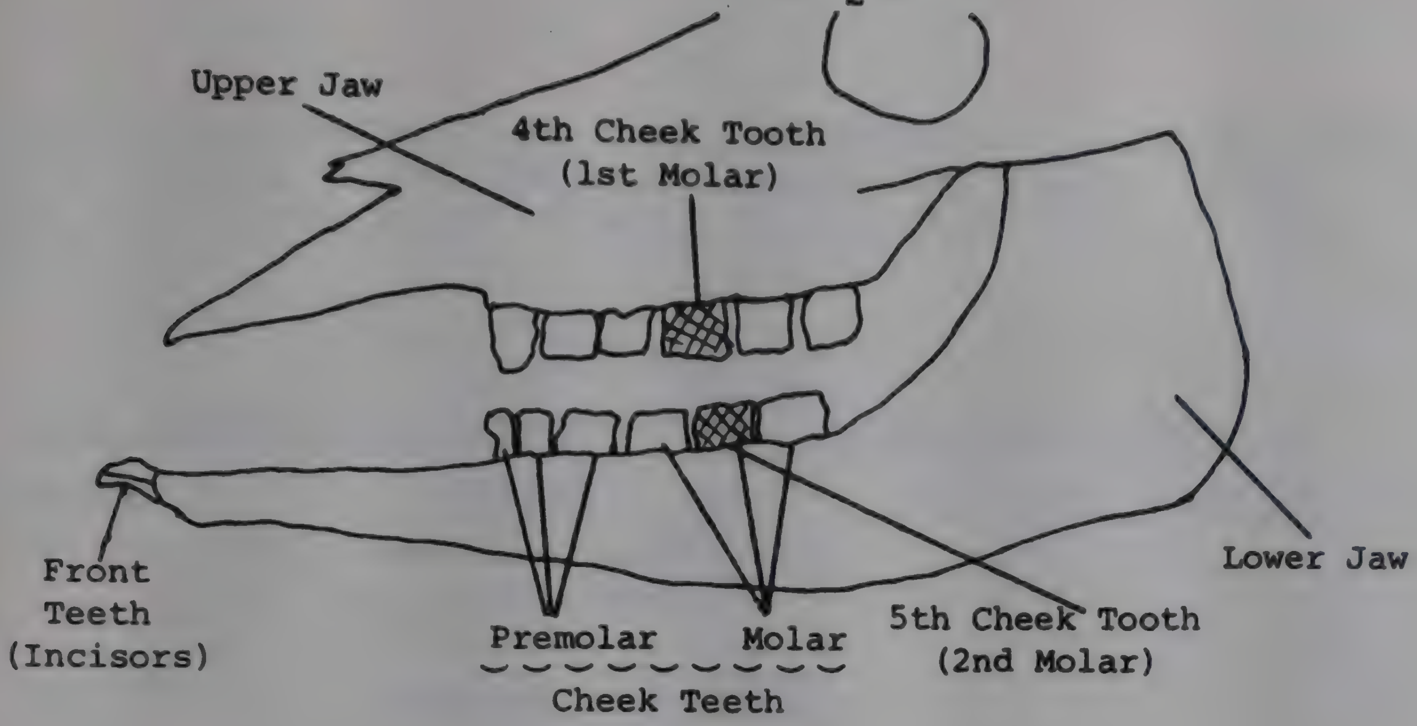

Figure 1: Left Side of Adult Ox Skull & Jaw

Eight incisor teeth (central, intermediate, lateral and corner) are found on the front part of the lower jaw only. The corresponding part of the upper jaw has no teeth but is provided with a pad. The cheek teeth are divided into two further categories - the molars and the premolars. Table 1 lists the number of teeth in each category present in a normal animal.

TABLE 1

THE NUMBER OF TEETH PRESENT IN NORMAL CATTLE & SHEEP

	Incisors	Cheek Teeth	
		Premolars	Molars
Upper Jaw	0	6	6
Lower "	8	6	6

DETERMINING THE AGE OF CATTLE FROM THEIR TEETH

The Australian Meat and Live-Stock Corporation classification scheme for cattle has six dentition categories (Table 2). There are no temporary molar teeth; therefore the first appearance of a fifth cheek tooth breaking through the gum (eruption) results in a carcass being placed in Category 1. Carcasses fall into Categories 2, 4, 6 & 8 when the temporary incisors are replaced by permanent incisors.

An examination of the teeth does not provide an accurate estimate of the chronological age of a particular animal. Overlapping has been observed at all stages within comparable groups of animals (for example, the appearance of four teeth in one animal before another animal in the same

group has two teeth). At best, an examination of the teeth only places an animal in a particular age range. Table 2 shows the likely range of ages (in months) for each tooth category.

TABLE 2

AGE RANGE FOR DIFFERENT TOOTH CATEGORIES OF BEEF

Category	Teeth	Age Range (months)
0	No permanent incisors, no 5th cheek tooth (second molar)	0 - 12
1	No permanent incisors, 5th cheek tooth (second molar) present	12 - 25
2	Two permanent incisors present	20 - 30
4	Four permanent incisors present	25 - 35
6	Six permanent incisors present	30 - 45
8	Eight permanent incisors present	40 +

Figure 2 shows a mouth with milk teeth only. Figures 3a) & 3b) show the first permanent incisor erupting and five cheek teeth. Figures 4a) & 4b) show two permanent incisors and six cheek teeth.

Figure 2: Milk Teeth Only

Figure 3(a): First Permanent Incisor Erupting

Figure 3(b): Fifth Cheek Tooth Erupted

Figure 4(a): Two Permanent Incisors

Figure 4(b): Six Cheek Teeth

The terms "Yearling Beef" and "Baby Beef" are used to specify export grades. Both these categories have weight and age specifications. The age specifications are Calf, Veal and Yearling Beef - no permanent incisors; Baby Beef - not more than four permanent incisors.

DETERMINING THE AGE OF SHEEP & LAMBS FROM THEIR TEETH

The age ranges for certain sheep and lamb categories are listed in Table 3.

TABLE 3

AGE RANGE FOR CERTAIN SHEEP & LAMB CATEGORIES

Category	Teeth	Age Range (months)
Lamb	No permanent incisors, no 4th cheek tooth (1st molar) upper jaw	0 - 5
Summer Lamb	No permanent incisors, 4th cheek tooth (1st molar) present in upper jaw	5 - 15
Hoggett	Two permanent incisors present	12 - 20
Four Tooth	Four permanent incisors present	18 - 30
Six Tooth	Six permanent incisors present	30 - 45
Full Mouth	Eight permanent incisors present	42 +

"Young sheep" is defined as anything up to and including four permanent incisors, and "mutton" is two to eight permanent incisors.

Figure 5 shows milk teeth. Figure 6 shows the upper jaw with three cheek teeth and the fourth just erupting. Figure 7 shows five cheek teeth in the lower jaw and four in the upper jaw (summer lamb).

Figure 5: Milk Teeth Only

Figure 6: Fourth Cheek Tooth Erupting

Figure 7: Summer Lamb

It should be noted that it is the presence of the first molar tooth in the upper jaw (i.e. the fourth cheek tooth) which divides the two categories of lamb. With young cattle it is the second molar in the lower jaw (i.e. the fifth cheek tooth) which determines the category of the carcass. In sheep and cattle the lower cheek teeth are more advanced in eruption than the upper teeth.

Dentition is an indication of animal age, and therefore potential meat tenderness. Nutrition and other factors, however, can affect its accuracy, and hence its usefulness.

ACKNOWLEDGMENT

We gratefully acknowledge the assistance of the Queensland Department of Primary Industries (in particular the photography by Mr. K. Beaumont), and the Australian Meat and Live-Stock Corporation.

ABSTRACTS

Below are some abstracts of recent publications which may be of interest. Copies of publications are restricted to the Australian meat processing industry and can be obtained by completing the attached form. Payment must be made in advance.

"THE COMPOSITION OF ANIMAL FEEDS," by Peter N. Wilson, *J. Sci. Fd Agric.* 1977, *28*, 717-727. 11p

This paper postulates that, as the competition between animal and human feed is now a cause for socio-political concern, it is likely that there will be a return to the situation in which the animal feed industry utilises raw materials surplus to, or non-competitive with, human food. A brief discussion on each of the most important nutrients follows, outlining their importance in animal feeds before explaining the role of "fillers" in animal feeds. Least cost formulation is then explained, before an attempt is made at a raw material classification where the point is made that a dietary formulation depends more upon the specification of the required nutrients than it does on identifying individually selected raw materials. However, materials will be accepted or rejected according to their "economic value."

Author's Abstract

"THE EFFECT OF MEAT pH AND PACKAGE PERMEABILITY ON PUTREFACTION AND GREENING IN VACUUM PACKED BEEF," by A.A. Taylor & B.G. Shaw, *J. Fd Technol.* (1977) *12*, 515-521. 7p

Beef joints at three pH levels were vacuum packed and stored at 1°C in materials with different gas permeabilities. Dark-cutting, high pH beef (pH 6.2-6.7) developed a green discoloration (greening) in all the packaging materials and had a putrid odour when the packs were opened after nine weeks. The same type of spoilage occurred at pH 5.9-6.1 in materials of relatively high gas permeability (73 and 92cm^3 O_2/m^2-day-atm. O_2 at 90% r.h.). Greening and putrefaction did not occur at pH 5.9-6.1 in materials of very low gas permeability (25 and 23cm^3 O_2/m^2-day-atm. O_2 at 90% r.h.), or in any packs of meat of normal pH (5.4-5.5).

Authors' Abstract

"THE EFFECTS OF SUSPENSION METHOD, CHILLING RATES AND POST MORTEM AGEING PERIOD ON BEEF QUALITY," by R.L. Joseph & J. Connolly, *J. Fd Technol.* (1977) *12*, 231-247. 17p

The combined effects of 'tenderstretch' (pelvic) suspension, slow chilling and extended post mortem ageing on beef quality in six hind quarter muscles have been investigated using young Hereford cross heifers.

In *M. Longissimus dorsi* at two days post mortem, tenderstretched fast (commercially) chilled meat was more tender than meat from normally suspended carcasses. Slow chilling produced still greater tenderness in both normal and tenderstretched carcasses. At seven days tenderstretched fast chilled meat had become as tender as slowly chilled meat but normally suspended fast chilled meat was not as tender, although it had undergone considerable tenderizing. These differences persisted to 14 days post mortem without any significant increase in tenderness occurring. Sarcomere lengths were increased by tenderstretching but were not reduced by fast chilling.

In *M. psoas major* tenderstretching produced a slight toughening and shorter sarcomeres. Slow chilling had no effect, and ageing produced a slight reduction in shearforce.

In *M. biceps femoris* tenderstretching greatly lengthened the sarcomeres but produced only a small tenderizing effect. Slow chilling and ageing had no effect.

In *M. semitendinosus* tenderstretching increased sarcomere lengths. A slight fall in shearforce was associated without interaction with both tenderstretching and ageing.

In *M. semimembranosus* slow chilling had no apparent effect while tenderstretching increased sarcomere length and produced meat that was more tender at two days than meat from normally suspended sides at 14 days. Ageing increased tenderness in both suspension treatments to about the same extent.

In *M. gluteus medius* tenderstretch suspension produced a marked tenderizing effect which persisted to 14 days. Ageing increased tenderness and, unlike other muscles, continued to be effective between seven and 14 days.

No experimental treatment had any deleterious effect on meat colour, drip loss or cooking loss. However, under slow chilling both carcass weight loss and bacterial growth, at two days post mortem, were enhanced, making slow chilling less attractive commercially.

Authors' Abstract

"THE EFFECT OF SEVERAL GASEOUS ENVIRONMENTS ON THE MULTIPLICATION OF ORGANISMS ISOLATED FROM VACUUM-PACKAGED BEEF," by Jane P. Sutherland, J.T. Patterson, P.A. Gibbs & J.G. Murray, *J. Fd Technol.* (1977) *12*, 249-255. 7p

Cubes of sterile beef were inoculated with pure cultures of Gram positive and Gram negative organisms isolated from vacuum-packaged beef and were stored in gaseous atmospheres containing different proportions of air, CO_2 and O_2 at 0 and 5°C. Generally the rate of multiplication decreased and the lag phase increased in increasing levels of CO_2, but Gram positive species were more resistant to the effect of CO_2 than were Gram negative organisms.

Authors' Abstract

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